7. UPSTREAM AND DOWNSTREAM FISH PASSAGE OPTIONS BY DAM

The following section contains descriptions of each of the upstream and downstream passage options examined at each of the dams. Each option uses one of the previously described concepts or a variation of the concept. Figures and Drawings are located in Appendix D. Table 7-1 summarizes the estimated construction and annual O&M costs of the various concepts.

Table 7-1. Estimated costs of upstream and downstream passage options

	Concept Construction Cost (in $1 millions) **Estimated Annual O&M** (in $1,000s ["k"]) *(Concept No.)*				
Upstream Passage					
	Keechelus	**Kachess**	**Cle Elum**	**Bumping Lake**	**Tieton**
Trap-and-Haul	Const = $7.0 O&M = $250k *(7.1.1)*	Const = $7.0 O&M = $250k *(7.2.1)*	Const = $7.0 O&M = $250k *(7.3.1)*	Const = $7.0 O&M = $250k *(7.4.1)*	Const = $7.0 O&M = $250k *(7.5.1)*
Fish Ladder with Pumped Flow	Const =$8.5 O&M = $260 *(7.1.2)*	Const =$8.5 O&M = $210k *(7.2.2)*	Const =$8.5 O&M = $380k *(7.3.2)*		
Fish Ladder				Const =$11.0 O&M = $15k *(7.4.2)*	
Downstream Passage					
Spillway Modifications	Const =$3.5-4.5 O&M = $20k *(7.1.3; 7.1.4)*	Const = $5.0 O&M = $20k *(7.2.3)*	Const = $2.2 O&M = $20k *(7.3.3)*	Const = $1.7 O&M = $20k *(7.4.3)*	Const = $2.5 O&M = $20k *(7.5.2)*
New Fish Spillway	Const =$8.0 O&M = $20k *(7.1.5)*	Const =$10.0 O&M = $20k *(7.2.4)*	Const =$10.0 O&M = $20k *(7.3.4)*	Const =$4.6 O&M = $20k *(7.4.4)*	Const =$42.0 O&M = $20k *(7.5.3)*
Fish Collection Barge	Const =$11.0 O&M = $340k *(7.1.6)*	Const =$11.0 O&M = $340k *(7.2.5)*	Const =$11.0 O&M = $340k *(7.3.5)*	Const =$11.0 O&M = $340k *(7.4.5)*	Const =$11.0 O&M = $340k *(7.5.4)*
New Outlet Works	Const =$25.0 *O&M = $320k *(7.1.7)*	Const =$25.0 O&M = $320k *(7.2.6)*	Const =$25.0 O&M = $320k *(7.3.6)*	Const =$20.0 O&M = $320k *(7.4.6)*	
* O&M cost for the downstream trap-and-haul method from the New Outlet Works					

7.1. KEECHELUS DAM – UPSTREAM AND DOWNSTREAM FISH PASSAGE OPTIONS

Keechelus Dam was the first facility examined in this overall assessment. The full range of upstream and downstream passage concepts were analyzed. Many of the concepts described are applied at the other dams; however, detailed descriptions and drawings are not repeated.

Option 7.1.1 Keechelus Dam Upstream Passage – Trap-and-Haul — This option is shown on Drawing 1. The barrier dam and fish collection facility are located in the river downstream from the point where the spillway channel enters the river. This is to prevent upstream migrants from swimming up the spillway channel and missing the fish trap facility. However, this would eliminate a reach between the barrier and the dam about 1 mile long. As an alternative, the barrier could be placed closer to the dam and a second barrier placed in the spillway channel.

A haul route would be built along the left bank of the river, extending to the left abutment of the dam. A ramp would be constructed from the crest of the dam down to the reservoir from which the fish transportation truck would back down to release fish into the reservoir. The alignment of the haul route (as shown on Drawing 1 in Appendix D) may pass through an area currently used as a materials borrow source for the Safety of Dams project work. This area is planned to be restored as a wetlands mitigation area. The final alignment of the haul route would be adjusted to minimize impacts to the wetlands.

The estimated construction cost for this option is $7 million.

Option 7.1.2 Keechelus Dam Upstream Passage – Fish Ladder with Pumped Flow — This option is shown on Drawing 2. A barrier dam would be constructed in the river at the ladder entrance to provide attraction flow into the ladder and prevent fish from swimming past the ladder entrance. The ladder would extend to the crest of the dam on the left abutment. However, a segment of the ladder might align through the wetlands mitigation area; if so, impacts would be minimized as much as possible. Fish would swim up the ladder to the false weir at the crest of the dam and then jump over the false weir into a chute that flows to the reservoir. Excavation of a channel at the end of the chute would be required for periods of low-reservoir-elevation.

The pump structure for the pumped ladder flow is located in the river just downstream from the end of the outlet works conduit. The ladder discharge pipe from the pump station to the false weir would be aligned next to the ladder.

The estimated construction cost for this option is $8.5 million.

Option 7.1.3 Keechelus Dam Downstream Passage – Modify Spillway with Single Level Gates — This option is shown on Drawings 3, 4, and 5. Drawing 3 shows the location of the spillway modifications and the extent of the channel excavations required for this option. Drawings 4 and 5 show the details of the modifications to the existing spillway. This option consists of four downward-operating slide gates that would allow a surface spill from the reservoir from above elevation 2507 feet. Figure 1 illustrates the timing and duration of downstream passage that would have occurred if this passage option was in place during WY 1994-2001.

After flow passes over the gates, it would enter a pool that is excavated in the spillway channel. A low-flow channel would be excavated downstream from the pool. The velocity for this flow would be approximately 6 feet per second.

The estimated construction cost for this option is $ 3.5 million.

Option 7.1.4 Keechelus Dam Downstream Passage – Modify Spillway with Multiple Level Gates — This option is shown on Drawings 6, 7, and 8. It would be essentially the same as Option 7.1.3 above, except that gates would be placed at multiple levels to permit a surface spill release from the reservoir at a lower elevation.

This option would allow a release from the reservoir to elevation 2497 feet and above. Figure 1 shows the time periods for downstream fish passage for this option. Drawing 6 shows the extent of the approach channel excavation required for the lower level discharge. The spillway modifications required would be similar to the Option 7.1.3.

The estimated construction cost for this option is $4.5 million.

Option 7.1.5 Keechelus Dam Downstream Passage – New Spillway — This option would be a new spillway adjacent to the existing spillway (as shown on Drawing 9). The spillway would include multiple-level gates to provide a surface spill discharge out of the reservoir from elevation 2480 feet and above. Figure 1 shows the time period when downstream passage would occur for this option.

Emigrating fish would enter the spillway through one of the downward operating slide gates and spill into a pool. The gate and pool in use depends on the water surface elevation in the reservoir. Water would flow out of the pool and into a chute. The chutes would merge into one chute at the downstream end that would then convey fish to the existing spillway channel and back into the Yakima River.

The estimated construction cost for this option is $8 million.

Option 7.1.6 Keechelus Dam Downstream Passage – Fish Collection Barge — This option would be the application of the fish collection barge described in Section 6.5.3 above. Drawing 10 shows the placement of the barges in front of the outlet works at Keechelus Dam. Drawing 11 shows sections and details of the system. This system could be used for downstream passage of fish through the entire range of reservoir water surface elevations.

This option would require the construction of an access bridge on the dam embankment. A jib crane on the bridge would be used to lift the hopper containing fish from the fish collection barge. The fish would then hauled by truck from the bridge to a release point downstream from the dam.

The estimated construction cost for this option is $11 million.

Option 7.1.7 Keechelus Dam Downstream Passage – New Outlet Works — Drawing 12 shows the new outlet works option at Keechelus Dam. The outlet works would function as previously described. This system could be used for downstream fish passage over the entire range of reservoir water surface elevations.

Two options for moving the fish downstream were previously described — a pipe extending through the outlet works conduit or a trap and fish-transfer hopper that could be lifted out and hauled

downstream from the dam by truck (section 6.5.4). The outlet works conduit at Keechelus Dam consists of an open-channel flow conduit with room at the top of the conduit for a fish bypass pipe, so that method is presented for this dam.

The estimated construction cost for this option is $25 million.

7.2 KACHESS DAM – UPSTREAM AND DOWNSTREAM PASSAGE OPTIONS

The full range of upstream and downstream passage concepts used previously at Keechelus Dam are applied at Kachess Dam. They are as follows.

Option 7.2.1 Kachess Dam Upstream Passage – Trap-and-Haul — This is assumed to be the same as Keechelus Dam Option 7.1.1. No drawing is provided. The estimated construction cost for this option is assumed to be about the same as for Keechelus Dam, $7 million.

Option 7.2.2 Kachess Dam Upstream Passage – Fish Ladder with Pumped Flow — This is assumed to be the same as Keechelus Dam Option 7.1.2. No drawing is provided. The estimated construction cost for this option is assumed to be about the same as for Keechelus Dam, $8.5 million.

Option 7.2.3 Kachess Dam Downstream Passage – Modify Spillway Gate — This option is shown on Drawing 13. It would be a fairly simple modification to the existing spillway at Kachess Dam that would allow a surface spill release from the reservoir from elevation 2254 feet and above. Figure 2 shows the time period when downstream passage could occur with this option.

The spillway at the dam contains a single 8-foot-high by 50-foot-wide radial gate. This option assumes replacing the radial gate with a "Rodney Hunt" crest gate that would discharge water over its top. Water would then flow down the existing spillway. A modification to the spillway invert by constructing a V-shaped channel would provide increased flow depth at minimum flow.

The estimated construction cost of this option is about $5 million.

Option 7.2.4 Kachess Dam Downstream Passage – New Spillway — This option would include construction of a new spillway in an abandoned spillway channel as shown on Drawing 14. It would allow a surface spill from elevation 2240 feet and above. Figure 2 shows the time period when downstream passage could occur.

The abandoned spillway is approximately 3,000 feet to the left of the dam. The spillway crest is 250 feet long. This option would require excavation of a channel upstream from the spillway down to elevation 2240 feet. The dike in the abandoned spillway would be excavated to allow the placement of an Obermeyer weir gate (or any overshot gate). Flow would pass over the weir and into a plunge pool. It would then flow down the abandoned spillway channel that is assumed to be lined with a geomembrane fabric and riprap. Information on the abandoned channel is not currently available; such data would be required to investigate this option further.

The estimated construction cost of this option is about $10 million.

Option 7.2.5 Kachess Dam Downstream Passage – Fish Collection Barge — This is assumed to be the same as Keechelus Dam Option 7.1.6. No drawing is provided. The estimated construction cost of this option is assumed to be about the same as for Keechelus Dam, $11 million.

Option 7.2.6 Kachess Dam Downstream Passage – New Outlet Works — This is also assumed to be similar to Keechelus Dam Option 7.1.7. No drawing is provided. The estimated construction cost of this option is assumed to be about the as for Keechelus Dam, $25 million.

7.3 CLE ELUM DAM – UPSTREAM AND DOWNSTREAM PASSAGE OPTIONS

The same upstream and downstream passage concepts examined for Keechelus Dam have been applied to Cle Elum Dam, and they are listed below. However, any proposed excavations through the natural foundation materials at Cle Elum Dam must consider a unique geologic feature. Cle Elum Lake has a natural layer of densely compacted, overconsolidated silt and clay lining the upstream edge of the terminal moraine that forms a very tight seal for the reservoir. This natural silt-and-clay lining was recognized early in the exploration of the site in the 1920s and the dam was constructed to take advantage of its presence. The natural lining likely contributes to the fact no seepage has ever been documented downstream from Cle Elum Dam or any of the three saddle dikes on the left abutment. Any excavations considered for fish passage structures need to keep the integrity of the natural liner in mind (Link 2002).

Option 7.3.1 Cle Elum Dam Upstream Passage – Trap-and-Haul — This is assumed to be the same as described in Keechelus Dam Option 7.1.1. No drawing is provided. The estimated construction cost of this option is assumed to be about the same as for Keechelus Dam, $7 million.

Option 7.3.2 Cle Elum Dam Upstream Passage – Fish Ladder with Pumped Flow — This option is shown on Drawing 15. It is assumed to be very similar to that described for Keechelus Dam Option 7.1.2. The estimated construction cost of this option is assumed to be about the same as for Keechelus Dam, $8.5 million.

Option 7.3.3 Cle Elum Dam Downstream Passage – Modify Spillway with New Gate — This option is shown on Drawing 16. It would be a fairly simple modification to the existing spillway at Cle Elum Dam that would allow a surface-spill release from reservoir elevation 2223 feet and higher. Figure 3 shows the time period when downstream passage can occur for this option.

The spillway at Cle Elum Dam contains five radial gates. This option assumes installation of an Obermeyer gate (or some other type of overshot gate) that discharges water downstream from one of the existing radial gates. The radial gate would be fully raised and remain in place as a backup to the weir gate. Water would then flow into a pool and down a chute formed by constructing a wall parallel to the existing spillway wall. The velocities in the chute would range from about 18 feet per second in the upper part of the spillway to about 40 feet per second in the steep section that enters the stilling basin. If the higher velocity is unacceptable, an alternative may be to extend the lower, steeper portion of the chute at a flatter slope.

The estimated construction cost for this option is $2.2 million.

Option 7.3.4 Cle Elum Downstream Passage – New Spillway — This option is shown on Drawing 17. It would consist of an excavated channel upstream from the spillway, a new spillway structure, and two concrete pipes to discharge fish to the downstream side of the dam. It would allow a surface spill discharge from the reservoir at elevation 2190 feet and above. Figure 3 shows the time period when downstream passage would have occurred for this option during WY 1994-2001.

Fish would enter the new structure through one of the multiple level gates and pass over a downward-operating slide gate. From this point, this option differs from the fish spillway option described for Keechelus Dam. Fish spill into one of a series of pools depending on the water surface elevation of the reservoir. The flow would drop over a weir to the next lower pool below. The maximum height drop would be 10 feet and to protect the fish, the pools would be of depths appropriate to the drop. At the bottom pool, flow would enter the concrete pipes that discharge into the existing spillway for a total discharge of 400 cfs; velocity in the concrete pipes would be about 11 feet per second.

After discharge into the existing spillway, the flow would continue down the spillway. A concrete wall could be constructed in the spillway to concentrate the flow into a minimum depth, similar to the previously described option. The velocity in the steep section of the spillway would be similar, approximately 40 feet per second. As was discussed for the previous option, the lower portion of the chute could extend farther downstream at a flatter slope. A second alternative would be to extend the concrete pipes further downstream at a flatter slope to reduce the velocity.

The estimated construction cost for this option is about $10 million.

Option 7.3.5 Cle Elum Downstream Passage – Fish Collection Barge — This is assumed to be the same as Keechelus Dam Option 7.1.6. No drawing is provided. The estimated construction cost of this option is assumed to be about the same as for Keechelus Dam, $11 million.

Option 7.3.6 Cle Elum Dam Downstream Passage – New Outlet Works — This is also assumed to be similar to Keechelus Dam Option 7.1.7. No drawing is provided. The estimated construction cost of this option is assumed to be about the same as for Keechelus Dam, $25 million.

7.4 BUMPING LAKE DAM – UPSTREAM AND DOWNSTREAM PASSAGE OPTIONS

The upstream passage concepts examined at Bumping Lake Dam include trap-and-haul and a traditional type of fish ladder with gravity flow. The downstream passage concepts are similar to those previously examined for Keechelus Dam; they are "New Gate on Spillway," "New Spillway," "Fish Collection Barge," and "New Outlet Works."

Option 7.4.1 Bumping Lake Dam Upstream Passage – Trap-and-Haul — This is assumed to be the same as Keechelus Dam Option 7.1.1. No drawing is provided. The estimated construction cost of this option is assumed to be about the same as for Keechelus Dam, $7 million.

Option 7.4.2 Bumping Lake Dam Upstream Passage – Fish Ladder — This option is shown on Drawing 18. The drawing shows a combined upstream and downstream passage system.

The upstream passage method is a fish ladder and the downstream passage method is a new spillway with downstream passage pipes. By placing the two systems together, flow from the downstream passage pipes would exit at the fish ladder entrance and provide attraction water flow. There may also be a cost savings from placing the systems in a parallel arrangement. (The option "Bumping Lake Dam Downstream Passage – New Spillway" is described in section 7.4.4 below.)

The fish ladder is an orifice type ladder similar to Reclamation's fish ladder at Easton Diversion Dam on the Yakima River. The ladder could function with a total differential of 34 feet, from the top of the pool (elevation 3427 feet) downward. This would be accomplished with the use of two ladder exits, each of which functions over a 17-foot range.

The ladder entrance would be located on the right side of the river close to the outlet works. This is the furthest point upstream that migrating fish could swim. The ladder would extend from the river to the right abutment of the dam. A channel would be excavated from the right abutment extending upstream. The depth of the channel required is to elevation 3390 feet. Further explorations and analysis are required to determine any dam safety implications of this channel.

The ladder is assumed to be designed to meet the current criteria for upstream passage for adult anadromous salmonids. However, it can be designed for other species that may have different passage criteria. The primary criterion is a 1-foot water surface differential between pools in the ladder. The ladder would achieve a 1-foot head differential between pools by sizing the orifice in the pool wall for one foot of head loss at the design ladder flow and the maximum reservoir pool at elevation 3427 feet. There is about a 36-foot water surface elevation differential between the maximum pool (elevation 3427 feet) and the water surface in the river (elevation 3391 feet). The 36-foot difference would be divided by 35 orifices and a 1-foot head loss at the ladder entrance gate. The top profile shown on Drawing 19 illustrates this flow condition.

As the reservoir water surface elevation drops, the head differential on each orifice would decrease and the flow through the ladder would decrease. To make up for the reduced flow, additional water would be added to the ladder by an auxiliary flow pipe. For example, when the water surface elevation in the reservoir is at elevation 3411 feet, additional water would be added by an auxiliary flow pipe that would enter the ladder downstream from Weir 19 to maintain the design flow in the lower-ladder section. The flow and head differential through the upper ladder would be reduced. When the water surface in the reservoir is below elevation 3411 feet, the lower fish exit gate would be opened and fish would swim up the lower ladder and through the channel to the lower ladder exit. As the reservoir water surface elevation drops below elevation 3410 feet, the flow and head differential decrease and additional water is added through the auxiliary flow pipe that enters below Weir 1. The bottom profile on Drawing 19 illustrates the low reservoir conditions.

This system of gates and valves on the auxiliary flow pipes requires adjustment for every change in the water surface elevation in the reservoir. This could be accomplished by daily monitoring and adjustment or by automation.

As previously noted, the concept was modeled after the Easton Diversion Dam fish ladder. However, the Easton ladder is designed for a maximum water surface fluctuation of 14 feet, rather than 17 feet as proposed by this design. Use of this type of ladder may require further biologic and hydraulic study and modeling to confirm its application at this site for all required species.

The estimated construction cost for the ladder-only portion of this option is about $11 million. (The New Spillway component is described in section 7.4.4 below.)

Option 7.4.3 Bumping Lake Dam Downstream Passage – New Gate on Spillway — This option is shown on Drawing 20. It consists of adding an Obermeyer weir gate to the crest of the uncontrolled concrete weir spillway that would allow a surface spill from the reservoir from above elevation 3420 feet. Figure 4 shows the time period for WY 1994-2001 that would have downstream passage for this option.

After flow passes over the weir gate, it would enter a pool that would be excavated in the spillway channel. Water would then flow into a chute that would be formed on the spillway by constructing a small wall parallel to the existing spillway wall. The velocities in the chute would vary from about 7 feet per second in the upper spillway to 35 feet per second in the lower spillway section. As an alternative to the higher velocities, the lower section of the fish chute could be extended at a flatter slope.

The estimated construction cost for this option is about $1.7 million.

Option 7.4.4 Bumping Lake Dam Downstream Passage – New Spillway — This downstream passage option is shown combined with the upstream passage fish ladder on Drawing 18. Flow would enter the system through multiple-level, downward-operating slide gates. The gates allow downstream passage over the full range of reservoir water surface elevations. Fish would spill into one of a series of pools depending on the water surface elevation of the reservoir. The flow would drop over a weir to the next lower pool below. The weir would also create a pool that flow and fish would enter. The maximum height drop would be 10 feet. The depth of pool would be sufficient to prevent injury to fish. At the bottom pool, flow would enter the concrete pipes that discharge downstream into the river. The velocity in the concrete pipe would be approximately 5 feet per second.

The estimated construction cost for this option is $4.6 million. (The fish ladder component is described in section 7.4.2 above.)

Option 7.4.5 Bumping Lake Dam Downstream Passage – Fish Collection Barge — This is assumed to be the same as Keechelus Dam Option 7.1.6. No drawing is provided. The estimated construction cost of this option is assumed to be about the same as for Keechelus Dam, $11 million.

Option 7.4.6 Bumping Lake Dam Downstream Passage – New Outlet Works — This is assumed to be similar to Keechelus Dam Option 7.1.7. However, Bumping Lake Dam is not as high has Keechelus Dam, so it would not require an outlet works structure as tall. No drawing is provided. The estimated construction cost is assumed to be somewhat less than for Keechelus Dam, $20 million.

7.5 TIETON DAM – UPSTREAM AND DOWNSTREAM PASSAGE OPTIONS

The upstream passage options considered for Tieton Dam are limited to trap-and-haul only. A fish ladder with pumped flow concept did not appear viable because of the dam's structural height (more than 300 feet), and it's location (in a narrow canyon). The downstream passage concepts are modifications to the existing spillway gates, a new spillway, and the barge collector. The New Outlet Works concept also was considered not viable because of the height of the dam and the

inability to extend an attraction flow pipe into the existing outlet works, as was proposed at Keechelus Dam.

Option 7.5.1 Tieton Dam Upstream Passage – Trap-and-Haul — This is assumed to be the same as Keechelus Dam Option 7.1.1. No drawing is provided. The estimated construction cost of this option is assumed to be the same as for Keechelus Dam, $7 million.

Option 7.5.2 Tieton Dam Downstream Passage – Modify Spillway Gate — This option would be a modification to the existing drum gates on the spillway at Tieton Dam by adding hydraulic cylinder operators to provide control of the gate crest. Drawing 21 shows this modification. It consists of adding hydraulic operators to one of the drum gates and modifications to the invert of the spillway. This would allow a surface spill from the reservoir to above elevation 2918 feet. Figure 5 shows the time period that downstream passage from the reservoir could occur for this option.

The modification would provide better control over the operation and crest elevation of the drum gate than is currently available. The minimum discharge at the gate would be 75 cfs. Once water passed over the gate, it would flow about 35 feet down a 0.5:1 slope to the concrete invert. The invert adjacent to the spillway would be modified with a circular cross section which would then transition to a V-shaped invert.

The spillway is 20 feet wide and 1,250 feet long. The longitudinal slope of the spillway varies; starting at 0.0938 ft/ft at the upstream end, changing to 0.0607 ft/ft, then changing to 0.233 ft/ft, then becoming flat at the lower end. Velocities down the spillway would vary with slope and flow. At a minimum flow of 75 cfs, the maximum velocity would be about 17 feet per second and depth of flow about 0.2 feet; at a flow of 200 cfs, the maximum velocity would be about 25 feet per second and depth of flow about 0.4 feet. A hydraulic jump would occur in the stilling basin at the base of the spillway; this may cause injury or mortality to juvenile fish.

The estimated construction cost of is about $2.5 million.

Option 7.5.3 Tieton Dam Downstream Passage – New Spillway — This option consists of a new spillway structure to bypass fish around the existing spillway. It would be located adjacent to the existing spillway. A plan of the system is shown on Drawing 22 and additional details are shown on Drawing 23. The facility would be designed to allow a surface spill from the reservoir at elevation 2900 feet and above. Figure 5 shows the time period that downstream passage would occur for the option.

Flow would enter the structure over two 10-foot-wide weir gates. The weir gates would be adjusted with hoists to allow a surface spill into the new spillway structure. After flowing over the weirs, fish would be separated by a 50-foot-long, angled, wedge-wire bar screen to guide them to a vertical well. The screened water would flow through a 4-foot-wide by 8-foot-high conduit extending through the existing spillway channel. In the vertical well, 14-inch gated orifices would be placed over the range of pool elevations (as shown on Section B-B on Drawing 23). The orifices would discharge flow into the pool-drop structure that lowers fish through a series of 8-foot drops over weirs to the entrance of the fish bypass conduit.

The 2-foot-diameter fish-bypass conduit would transport fish on a slope of 0.03 ft/ft for approximately 6,500 feet to the river. The bypass conduit would be placed in the spillway with a concrete encasement or possibly buried in the spillway channel until it diverges away from the spillway. It would then follow the existing ground slope until it reached a suitable outfall. The maximum velocity in the bypass conduit would be 17 feet per second.

The estimated construction cost of this option is about $42 million.

Option 7.5.4 Tieton Dam Downstream Passage – Fish Collection Barge — This is assumed to be the same as Keechelus Dam Option 7.1.6. Dam. No drawing is provided. The estimated construction cost of this option is assumed to be about the same as for Keechelus Dam, $11 million.